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## MATERIALS FOR A REVISION OF EAST COAST AND FLORIDAN VOLUTES

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The Volutidae are comparatively rare shells in the Recent fauna of eastern North America and the Caribbean region, and most species can be obtained only by dredging in off-shore waters. *Scaphella* has recently become more easily available to collectors from the shrimp trawlers. *Voluta musica* and its several subspecies or varieties is probably the commonest of the West Atlantic volutes and is locally plentiful along certain portions of the north coast of South America from the Goajira peninsula of Colombia eastward to Margarita Island and Trinidad. Westward of the Goajiras, *V. musica* is replaced by *V. virescens*, which extends northward along the Central American coast to Texas. We have records of *virescens* from Cartagena, Colombia, and Colon, Panama. These two species are distinguishable by their color markings and by very marked differences in their nuclear construction. A fossil form of *V. virescens* is common in the Miocene of western Panama and Costa Rica.

In Florida waters only the Scaphellinae appear to be represented. An important paper on this subfamily was published by William J. Clench in *Johnsonia*, vol. 2, no. 22, 1946. Clench's work was based on a study of the combined collections in the National Museum, the Academy of Natural Sciences of Philadelphia, the Museum of Comparative Zoology, and the Museo Poey in Havana. It is the indispensable foundation for further work on these elegant but elusive mollusks.

In recent years the McGinty brothers, together with Arthur

R. Thompson, in dredging operations from Mr. Thompson's motor yacht *Triton*, principally along the southeast coast of Florida and the Keys, have brought together a series of *Aurinia* and its allies probably larger than any collection previously available for study. The material and information assembled by them, together with Thomas L. McGinty's studies of the radulae, form the chief basis of this paper. We are deeply indebted to Mr. Charles R. Locklin and to Mr. Thomas L. McGinty for gifts of rare and valuable specimens, and to Mr. Tom Dow and Mrs. E. L. Townsend for the use of volutes from their collections.

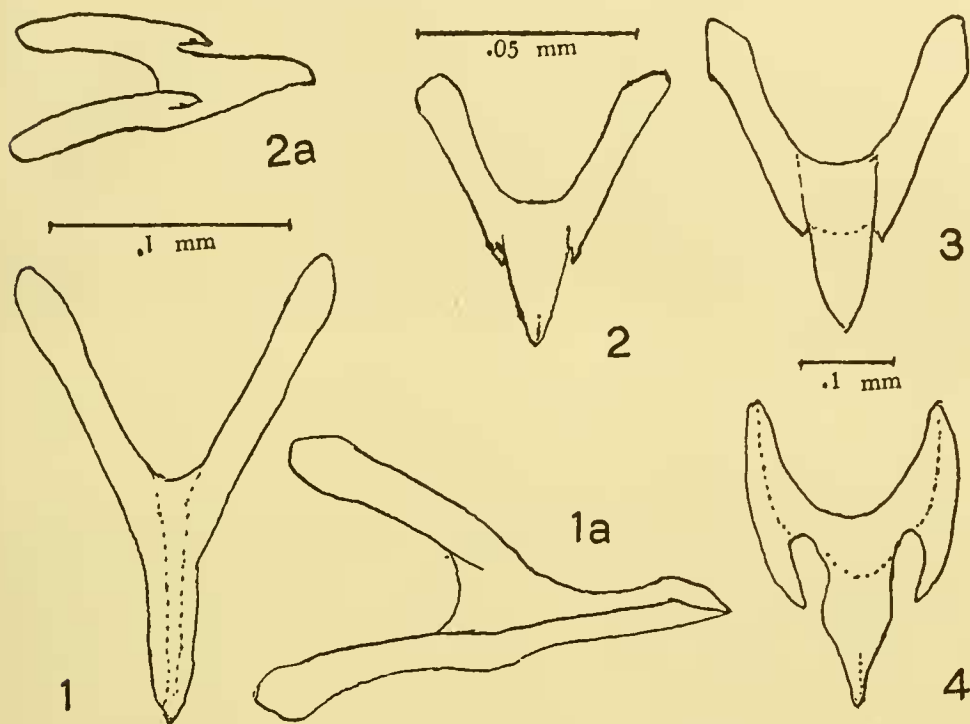
Clench first indicated the existence of a radula in the American species of Scaphellinae, and gave figures of the teeth of five species. Dall, who had failed to obtain a radular ribbon from a specimen (erroneously) identified as "*Aurinia dubia*" dissected for the *Blake* report, 1889, concluded that the absence of a radula constituted a characteristic of the subfamily, an error copied later by Thiele and several other systematists. The radular ribbon of the Scaphellinae, as in most other volutes, is uniserial, lateral teeth being absent, so that only the central row or rachidian teeth remain. The ribbon is small to minute. As figures 1 to 4 show, the teeth of *Scaphellinae* are of three patterns. All have a biramose base of attachment.

1. In SCAPHELLA the teeth have a single long, narrow cusp only, its upper surface deeply concave (as in fig. 1a), the shanks of the base either shorter than the cusp, as in *S. junonia* as figured by Clench, or longer and more spreading, as in the Campeche race or subspecies drawn in our figures 1, 1a.

2. In CLENCHINA there is a conic central cusp deeply concave above, suggesting the upper surface of a rounded shovel (fig. 2a), and two minute accessory cusps, which are the sharpened ends of two ridges continued from the lateral edges of the basal shanks. The radula is minute, about 2 mm. long, teeth 0.05 mm. wide, more or less, in the type species *C. dohrni* (Sowerby), figs. 2, 2a. The teeth are similar in *C. florida* (Cl. & Ag.), and in *C. robusta marionae*, fig. 3.

3. In *AURINIA* there is a pointed central cusp and two well developed side cusps. The radula is relatively large, in the neighborhood of 10 mm. long, with teeth about 0.2 mm. wide, in *A. georgiana* (Clench), fig. 4. *Aurinia kieneri ethelae* (pl. 3, fig. 1), has a radula very similar to *A. georgiana*.

In *Volutifusus* the teeth are shaped as in *Aurinia*, but the radula is much smaller, 2 mm. long in a shell of *V. torrei* (Pilsbry) 54 mm. long, according to Clench.



FIGS. 1, 1a. Tooth of *Scaphella junonia butleri* from shrimp grounds southwest of Campeche in 16 fms. Shell 112 mm. long. Radula about 6 mm. long, with approximately 210 teeth, formula 0.1.0. At fig. 1a a tooth viewed obliquely from side and above.

FIGS. 2, 2a. *Clenchina dohrni* from rocky reef southeast of Sombrero Key Light, 110 fathoms. Shell 43.3 mm. long, clean and not eroded. Radula about 2 mm. long, with approximately 120 teeth. At fig. 2a a tooth seen from side and a little above.

FIG. 3. *Clenchina robusto marionae* from shell figured on pl. 2, fig. 5, Scale about same as for fig. 2.

FIG. 4. *Aurinia georgiana* from off Palm Beach, 115 fms. Radula slightly less than 10 mm. long, with about 160 teeth.

All figures except fig. 3 traced from camera lucida drawings by Thomas L. McGinty.

*Classification of East Coast and Floridan Volutidae*

## Subfamily Scaphellinae

## Genus SCAPHELLA Swainson, 1832

Type by subsequent designation, Gray, 1847: *Voluta junonia* Shaw. Recent, Florida coasts westward into the Gulf of Mexico.

The shell is broadly spindle-shaped, medium or thick-walled, the spire a third the total length or less. Protoconch subtruncate, stump-shaped, often with a pointed calcarella. Early postnuclear whorls having small axial ribs and spiral striae, the last whorl with spiral striae weak or vanishing and an extremely thin and pale periostracum, usually scarcely noticeable. Columella margin of aperture nearly straight, bearing four plaits. Parietal callus a thin and transparent glaze, at its widest extension covering about half the width of the ventral face or less. The anterior canal is rather short, stout, slightly recurved, with deep terminal notch and a distinct but low siphonal fasciole. Teeth of the radula with a single cusp (as described on page 2 and figs. 1, 1a).

## CLENCHINA, new genus

Type: *Voluta dohrni* Sowerby, 1903.

The shell is fusiform, similar to *Scaphella* by the nucleus, the numerous rows of spots, usually 8 or more (rarely wanting), and the limited parietal glaze, restricted to the columellar half or less of the ventral surface of the shell (pl. 1, fig. 4, *C. dohrni*). Three of four plaits emerge on the columella. A siphonal fasciole is more or less evident. The early postnuclear whorls may have spiral striation only, or axial ribs may be present also. Fine spiral striation extends upon the last whorl. The radula is very minute, the teeth having mesocone and vestigial side cusps, as described on page 2 and figs. 2, 2a, 3.

This genus differs from *Scaphella* chiefly by the form of the radular teeth, which are shorter and have distinct though minute side cusps. Such differences as exist in the shells do not seem very important, the *Clenchinae* being somewhat less solid and less shouldered.

*Clenchina* differs from *Aurinia* mainly by the much more minute radula, with teeth having only rudimentary side cusps. The shell differs by the stronger columellar plaits, the more numerous rows of spots, and especially by the far less extended parietal glaze; but this most important character is often faintly

or not at all expressed in fresh shells, and is usually removed in those which have been "cleaned."

The genotype, *C. dohrni*, lives in rocky stations. It is apparently confined in Florida waters to the rocky area off the Keys known as the Pourtales Plateau.

"*Voluta*" *gouldiana* Dall, with a unicolored shell or with broad pale bands, is referable without doubt to *Clenchina*, but the dentition is still unknown.

#### Genus AURINIA H. & A. Adams

*Aurinia* H. & A. Adams, 1853, monotype *Voluta dubia* Broderip.

*Rehderia* Clench, 1945, type *Aurinia schmitti* Bartsch. *Auriniopsis* Clench, 1953, *Johnsonia* 2: 378, type *Scaphella kieneri* Clench.

Distribution: Southeast Atlantic coast of the United States, Florida and the West Indies.

The shell is spindle-shaped and rather thin. Protoconch subtruncate stump-like or somewhat globose, often with a pointed calcarella. Whorls generally sculptured with fine spiral threads, the spire whorls (which may be shouldered) having axial folds as well. Columellar margin nearly straight or weakly sigmoid. There are two feeble columellar plaits, sometimes not persisting into the adult stage of the shell. Anterior canal long, straight or little recurved, terminating in a shallow notch. There is no siphonal fasciole. The periostracum is extremely thin, not concealing the color pattern of about 6 (5 to 7) spiral rows of brown spots; or (on mud bottom) the periostracum is slightly thicker, dull and opaque, dusky yellow, brownish or olivaceous. The parietal callus is an extremely thin glaze *spreading over much or most of the ventral surface* of the shell. Radula with tricuspid teeth as described on page 2 and fig. 4.

The chief feature differentiating the shell of *Aurinia* from other Scaphellinae is that the thin callus or glaze deposited by the columellar margin of the mantle covers most or all of the ventral face of the shell, covering also such incrustations as may adhere to the periostracum. In *A. georgiana* it may cover most of the apertural side of the last whorl only, as in plate 1, fig. 2, or it may extend on the ventral side over sutures and whorls, to the apex. In the long series seen from off Palm Beach there are all intermediate stages. This condition is obvious in most specimens from muddy bottom, which have the periostracum a little

thicker and darker than those from sandy or rocky bottoms. In the latter such very thin periostracum as may be present is transparent, the flesh colored or pinkish surface with rows of spots showing through; the ventral glaze is extremely thin, or so slight that none is visible, the spots showing through it, and the mantle line on the shell defining it is inconspicuous or no line may be visible.

Most specimens of *Aurinia* in collections have been "cleaned," and the mantle line on the shell defining the ventral glaze is faint or generally obliterated entirely.

The anterior canal is not, or but very slightly, recurved in *Aurinia*, and there is no trace of the convex siphonal fasciole seen in *Scaphella* and usually in *Clenchina*.

*Rehderia* was based upon specimens with dull, more or less incrustated periostracum, covered by the parietal glaze which had not been "cleaned." The type of *Aurinia* was a specimen with very thin periostracum and imperceptible ventral glaze. Their essential generic identity is demonstrated by the series of dozens of specimens dredged by the McGinty brothers, preserved in their natural condition except for the removal of the sea anemones which were on most specimens. All conchological characters of *Aurinia* and *Rehderia* are exactly the same except for the difference in the surface, which as noted above is fully covered by transitional individuals in "*Rehderia*" *georgiana*. We agree with Dr. Bartsch, who referred the genotype of *Rehderia* to the genus *Aurinia*.

The McGintys report that species of the genus *Aurinia* live in sandy or muddy situations, while members of *Clenchina* live in both rocky or sandy mud localities.

Some confusion has attended the identification of the genotype *Aurinia dubia* Broderip. Originally described and figured by Broderip in 1827, it was based on a shell from an unknown locality. The same figure was copied by Reeve who was not otherwise acquainted with the species. The original figure of *dubia* shows a slender shell about 65 mm. in length, with a rather long, slender, straight anterior canal, and a large bulbous protoconch tipped with a pointed calcarella. There are six rows of well separated brown spots on the body whorl, two rows on the penultimate whorl. The columellar plaits are described as

two in number, "very slightly marked." A photographic copy of Broderip's figure is reproduced in our plate 2, fig. 2. It appears to be a young shell which would add another whorl, the axially costate last whorl shown in Broderip's figure corresponding to the penult whorl of *A. kieneri*. The "two almost imperceptible plaits on the columella" of the immature stage represented by Broderip's type would probably be lost in the fully mature stage, as they are occasionally in *A. georgiana*. In *A. kieneri* the plaits evidently disappear still earlier. The nuclear shell of *A. dubia* is larger than in *A. kieneri* but of the same shape; cf pl. 2, fig. 1a. If this estimate is correct, *Auriniopsis* will fall as a synonym of *Aurinia*.

#### Genus VOLUTIFUSUS Conrad, 1863

*Volutifusus* Conrad, 1863, Proc. Acad. Nat. Sci. Phila. for 1862, p. 563.

*Bathyaurinia* Clench & Aguayo, 1940, Mem. Soc. Cubana de Hist. Nat. 14: 92 (Type *Aurinia torrei* Pilsbry).

Type by monotypy: *Fasciolaria mutabilis* Conrad, 1834, Miocene of St. Mary's River, Maryland.

The shell is smooth except for obscure axial riblets and spiral striae on the earliest post-nuclear whorls. It does not have the pattern of spots in spiral series characteristic of most Scaphelinae. The surface is covered by a light glaze of enamel which wholly or mainly obscures the sutures and spreads over the protoconch as well. Anterior canal nearly or quite straight, with siphonal canal notch small; without a siphonal fasciole. Columella plain in the adult, with two small plaits developed in early whorls only, but not emerging to the aperture in the adult stage. Radula as in *Aurinia* but much smaller.

To this genus belong several fossil species often referred to *Aurinia*, from the East Coast Miocene and Pliocene. *Volutifusus* differs from the closely related *Aurinia* by having the surface completely covered by a glaze of enamel from which it may be inferred that the mantle can be extended to envelop the whole shell. In shape of the radular teeth *Volutifusus* (*Bathyaurinia*) is entirely like *Aurinia*.

*Bathyaurinia* Clench and Aguayo, 1940, differs in no wise from *Volutifusus* in shell characters and is regarded as a synonym.

*Volutifusus aguayoi* (Clench) from deep water east of St.

Augustine is the only Recent species of this genus known from off Florida.

*List of Volutidae of the East Coast, Florida, and  
westward in the Gulf*

*Scaphella junonia* (Shaw)  
*Scaphella junonia johnstoneae* Clench  
*Scaphella junonia butleri* Clench  
*Clenchina dohrni* (Sowerby)  
*Clenchina florida* (Clench & Aguayo)  
*Clenchina gouldiana* (Dall)  
*Clenchina robusta* (Dall)  
*Clenchina robusta marionae* Pilsbry & Olsson  
*Aurinia kieneri* (Clench)  
*Aurinia kieneri ethelae* Pilsbry & Olsson  
*Aurinia schmitti* Bartsch  
*Aurinia georgiana* (Clench)  
*Volutifusus aguayoi* (Clench)

*Notes and descriptions of some Scaphellinae*

CLENCHINA ROBUSTA MARIONAE, new subspecies. Pl. 2, figs. 4, 5

The shell is rather shortly fusiform, the diameter contained about  $2\frac{1}{5}$  to  $2\frac{2}{5}$  times in the length, moderately solid; dull whitish with squarish dark brown spots in 5 or 6 spiral series. The nucleus has an elevated point, but is eroded in both specimens seen. Postnuclear whorls angular near the middle, the angle closely set with tubercles which are slightly lengthened axially. These tubercles continue over the first half or more of the last whorl; the angle and tubercles disappearing on the latter part of the whorl. Spiral sculpture of low, rounded cords wider than their intervals, about two cords in one millimeter (measured on the last whorl below the shoulder). The cords are smaller and closer above the shoulder and a trifle coarser towards the base. The arcuate outer lip of the aperture is a little more strongly curved in its posterior half. The inner lip is very weakly sigmoid, being slightly concave in the middle and curved towards the left anteriorly; the anterior canal being somewhat recurved, without a distinct siphonal fasciole. There are three low columellar plaits, not visible in front view in the type, but barely emerging in the paratype.

Length 45.3 mm., diameter 20 mm.; length aperture 32 mm.  
Type.

Length 59 mm., diameter 24.3 mm.; length aperture 40.5 mm.  
Paratype.

“Gulf of Mexico.” Type 189920 ANSP., paratype in Charles R. Locklin’s collection.

The special feature of this subspecies is the spiral sculpture which is far coarser than in any of the otherwise similar species. The anterior canal is distinctly recurved. The very thin parietal glaze is about as in *C. florida*, (pl. 1, fig. 4), at the widest extending about half way over the ventral side. In the type the squarish spots are somewhat longer axially, but in the paratype they tend to be lengthened spirally.

This subspecies is based upon two specimens, both probably mature, the difference in size thought to be sexual. The spiral striation is decidedly coarser than in *C. florida*. Though apparently adult the shells are much smaller than *C. robusta*. It is named for Marion (Mrs. C. R.) Locklin, formerly Assistant in the department of mollusks, Academy of Natural Sciences of Philadelphia.

AURINIA KIENERI (Clench), Plate 2, figs. 1, 1a.

*Fusus tessellatus* Schubert, Kiener, 1840, Icon. Coquilles Vivantes 5, *Fusus*, p. 39, pl. 29, fig. 1. [Not *F. tessellatus* Schubert & Wagner, 1829.]

*Scaphella (Aurinia) kieneri* Clench, 1946, Johnsonia 2:58, pl. 31, fig. 1 [copied from Kiener, l.c.; not *Auriniopsis kieneri* Clench, 1953].

This species was named by Clench from Kiener’s figure and description, no specimens being then known in America. It is now known by specimens from rather deep water in the north-eastern Gulf, one from the Locklin collection figured on plate 2, fig. 1. The shell is light pinkish cinnamon (of Ridgway) in color with six rows of squarish spots of vandyke brown, spots of the upper row small and scattered; the anterior end is vandyke brown with blackish streaks. The embryonic shell of slightly over two whorls is globular and runs spirally to an acute point. The penult and nearly two earlier whorls have rounded axial ribs on the lower half or slightly more, but obsolete on the concave upper part. There are widely spaced traces of ribs in the peripheral part of the last whorl. Fine spiral striae are over all post-embryonic whorls. No trace of columellar plaits. The specimen is adult, having several strong wrinkles indicating former peristomes behind the outer lip.

Length 115 mm., diameter 36 mm.; length of aperture 86.5 mm.;  $5\frac{3}{4}$  whorls.

These specimens agree in the main with Kiener's figure, but the aperture is a little narrower and the columellar margin is less strongly sinuous. *The strong ribs of the penult whorl* and the minute spirals of the glossy surface are the same.

In the shell figured as *A. kieneri* in Johnsonia 2:379, pl. 187 (1953) the absence of ribs on the penult whorl and the straighter columellar margin of aperture and canal indicate that it is not typical *A. kieneri*, but is referable to the following subspecies.

AURINIA KIENERI ETHELAE new subspecies. Pl. 3, figs. 1, 2, 2a.

Shell large, spindle-shaped, thin-walled, of almost paper thickness at the apertural edge, somewhat heavier elsewhere. The body-whorl is large, moderately convex but with its opposite sides in the middle zone appearing a little flattened and parallel; above that the surface slopes inward to form an appressed zone bordering the suture. Base of whorl is contracted rather strongly and produced into a narrow, straight to slightly twisted canal. The specimen has 5 whorls in addition to a small calloused nucleus of about 1 whorl which has an elevated, peaked calcarella. The first postnuclear whorl is quite narrow, the change from the nuclear stage being abrupt. Second and third postnuclear whorls have about 17 narrow, axial riblets across the middle but they fade out towards the suture. On the remaining whorls the ribs rapidly diminish and are wholly lacking on the penultimate and final whorls. Spiral sculpturing is relatively strong except on the body-whorl where the surface is nearly smooth except for the longitudinal lines of growth. The shell has a thin-edged growing lip, nearly straight or but slightly sinuous in the middle; but about a quarter turn back the growth lines are bunched together and heavier, indicating halts in shell growth.

Length 182 mm., greater diameter near upper end of aperture 54.5 mm.; height of spire above end of aperture 57 mm.

The contracted animal in formalin has a length along the foot of about 70 mm., of a dirty cream color smudged irregularly with black. Tentacles broad, triangular, flat, with a small protuberance on each side at the outer base, probably bearing small eyes. Buccal mass is a large, sausage-shaped, thick-walled organ. The radula is relatively long and very slender, approximately 12 mm. in length, width of teeth about 0.28 mm., the individual teeth closely similar to those of other *Aurinia*, each with three cusps, the mesocone largest, widest in the middle, side cusps long.

Off South Pass, Mississippi River in 220 fathoms. Coll. by Mr. Thomas Dow. Holotype in the private collection of Mrs. Ethel L. Townsend, Coconut Grove, Florida.

We have seen a number of specimens, the type in the collection of Mrs. Townsend being the largest, our illustrations being a few mm. less than actual size. It differs from *A. kieneri* by the far less developed axial ribbing of the spire which is restricted to one or two early whorls, and totally absent on the last two or three whorls. In the specimens of *A. kieneri* seen, and in that figured by Kiener, the costation is strongest on the penult whorl. It remains to be seen whether *ethelae* is specifically distinct from *A. kieneri* when longer series of both become available. For the present, in view of the variability we have observed in some other species of *Aurinia*, we leave it as a subspecies.

No parietal glaze is usually visible on the ventral side of this form, but in one specimen (pl. 2, figs. 3, 3a) given by Mr. C. R. Locklin the surface had gathered a thin coat of diatoms or other marine deposit over which the mantle has laid a glaze covering the ventral side, exactly as described for "*Rehderia*." This is another illustration of our contention that *Aurinia* species may either occur clean, or incrustated individuals may have a glaze deposited over the incrustation. As this gives the shell quite a different appearance we give here a description of such an incrustated specimen.

Plate 2, figs. 3, 3a. The fusiform shell is long and slender, the diameter one-third of the length or less; not very thick. The nuclear  $1\frac{1}{3}$  smooth whorls taper spirally to a high point, as in *A. kieneri*. First postnuclear whorl is axially ribbed with spiral threads, the ribbing becoming weaker and irregular on the following whorl, the last  $2\frac{1}{2}$  whorls smooth except for fine growth striae. The whole ventral face of the last two whorls is covered with a white glaze, also covering the suture. The color, visible on the back and spire, is pinkish buff with two rows of russet squarish spots on whorls of the spire, four rows (with traces of a fifth) on the last whorl. The spots are rather small (3 mm. long more or less) on the last whorl, the rows widely spaced. The aperture is flesh tinted within, showing the spots faintly, widest at the anterior third. The outer lip is strongly curved forward in the middle, as usual, retracted to the suture. Columellar margin is very weakly concave in the middle, without plaits.

Length 128 mm., diameter 39 mm.; length of aperture 86.5 mm.;  $5\frac{1}{4}$  whorls.

The shape and color-pattern, as well as the less extensive glaze, differentiate this form from *Volutifusus*.

AURINIA SCHMITTI Bartsch. Pl. 1, fig. 1.

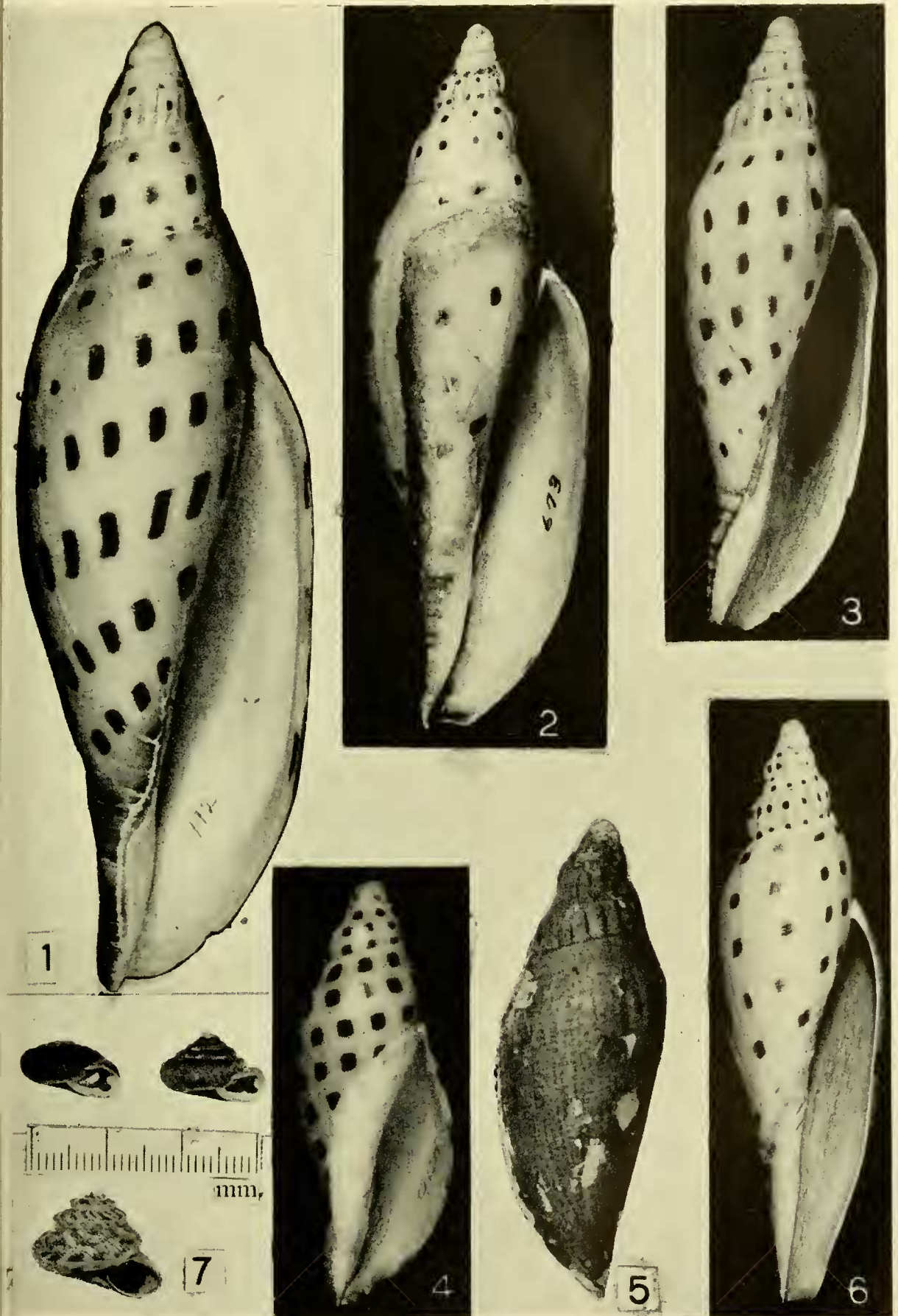
A specimen in the McGinty collection is figured to show the appearance when found clean. The last whorl is more evenly convex and less shouldered than the type figures of *A. schmitti*, but that type specimen is a little abnormal from an interruption of growth in the sutural region near the aperture. There are six spiral rows of squarish spots, those of the upper row small, the rest larger and separated by spaces usually less than twice the size of the spots. The aperture is widened at its anterior third, and about 69 percent of the total length. The columellar margin is nearly straight, and in an oblique view shows two very low but wide columellar plaits. In another specimen the plaits emerge more, being visible in a front view.

Length 130 mm., diameter 41 mm.; length of aperture 89.4 mm.

This specimen is from *Triton* Station 992,  $165^{\circ}$  off Sombrero Key Light in 60 fms., gray mud. It was taken July 21, 1952.

AURINIA GEORGIANA (Clench). Pl. 2, figs. 2 to 6.

*Aurinia georgiana* on muddy bottom off Palm Beach in about 75 to 90 fathoms is one of the usual perches for sea anemones. Sometimes several of them occupy the whole surface leaving only the aperture free. Even this may sometimes be contracted by encroachment of this old man of the sea. Other specimens, especially those from sandy bottom, may come up entirely clean, as in pl. 1, figs. 3, 6. The extension of the parietal glaze over the periostracum, as emphasized by Clench in his account of *Rehderia*, is not an unusual condition in shells with thin periostracum, in which, as in many land shells, the glaze is laid on over the periostracum. On muddy bottoms many *Aurinias* acquire a coating of lime, often with diatoms and other growths. Over this the columellar margin of the mantle deposits a glaze, so that a smooth surface rests upon the extended animal. The back of a coated specimen is shown in pl. 1, fig. 5. See also pl. 2, figs. 3, 3a.



1, *Aurinia schmitti*. 2, 3, 5, 6, *A. georgiana*. 4, *Clenchina dohrni*. 7, *Triondopsis fraudulentula vulgata* (above), *Anguispira alternata* (below).